

# Uncertainty worksheet

## graphing

### pendulum lab graph T vs root L and T vs A

1.  $38.6 \pm 0.1 \text{ cm}$

range/2 =  $(38.7 - 38.5)/2 = 0.1$

2.  $0.19 \pm 0.01 \text{ mm}$  or  $0.20 \pm 0.01 \text{ mm}$

$4.122 \pm 0.005 \text{ mm} - 3.925 \pm 0.005$

$4.122 - 3.925 = 0.197$

uncertainty =  $0.005 + 0.005 \text{ mm}$

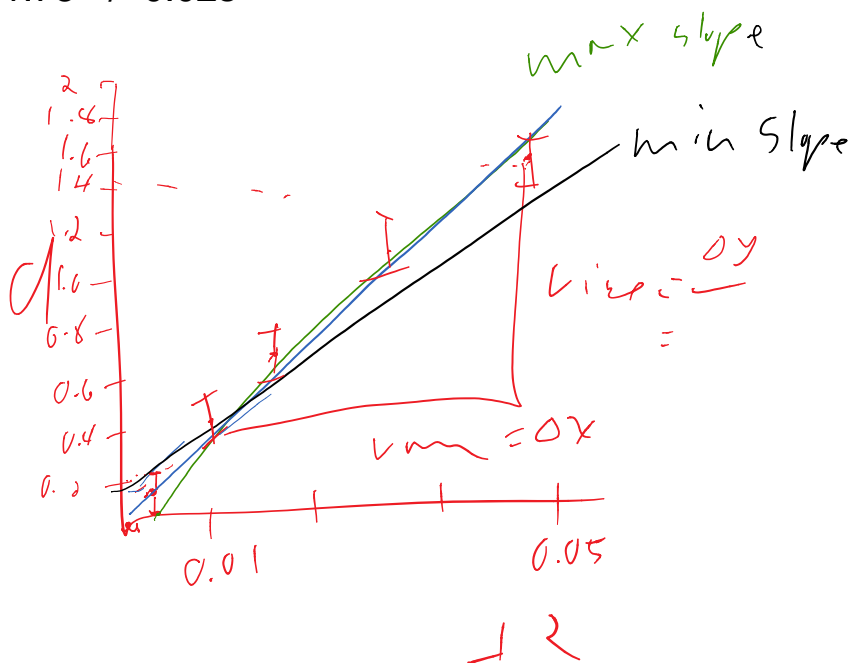
4. minimum =  $\pm 0.01 \text{ s}$

$1.726 \text{ s} \pm \text{at least } 0.001 \text{ s}$

but if assume a reaction/anticipation time of  $0.2 \text{ s}$

then  $1.73 \pm 0.02 \text{ s}$

10.



## Graphing

<http://physics-pages.wikispaces.com/file/view/Graphing%20tips.pdf/560059391/Graphing%20tips.pdf>

What do you need for a graph?

Title - say something about the collection

don't just say d vs t

eg. "A Ball Rolling Down a Slope"

axes with labels, units and an even scale

plot the points with uncertainty bars

best-fit line- DO NOT CONNECT THE DOTS

draw a smooth line close to all the data points,  
preferably through all the uncertainty bars

if the line is linear - use a ruler, determine the  
slope,  $m = \text{rise/run} = \Delta y / \Delta x$

don't forget units in the slope

determine the y intercept

determine uncertainties if uncertainties are given

uncertainty in the slope =  $\text{max slope} - \text{min slope} / 2$

if the line is not linear

then you straighten it by transforming the data to  
make it work

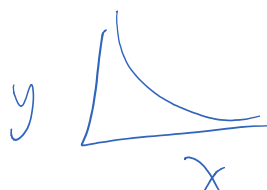


parabola  
 $y \propto x^2$

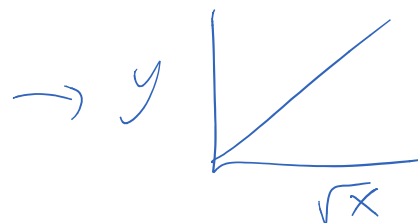
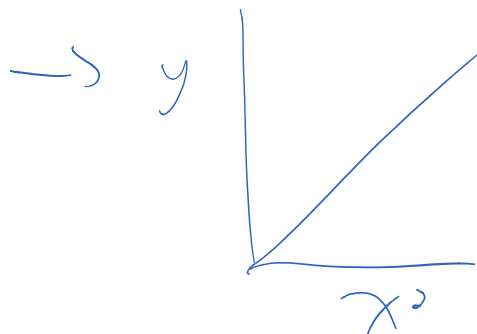
$$y \propto x^2$$



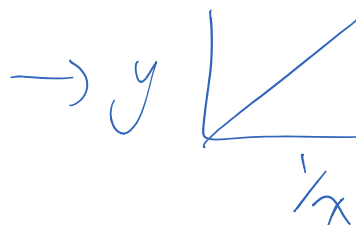
Parabola



Hyperbola  
reciprocal relationship

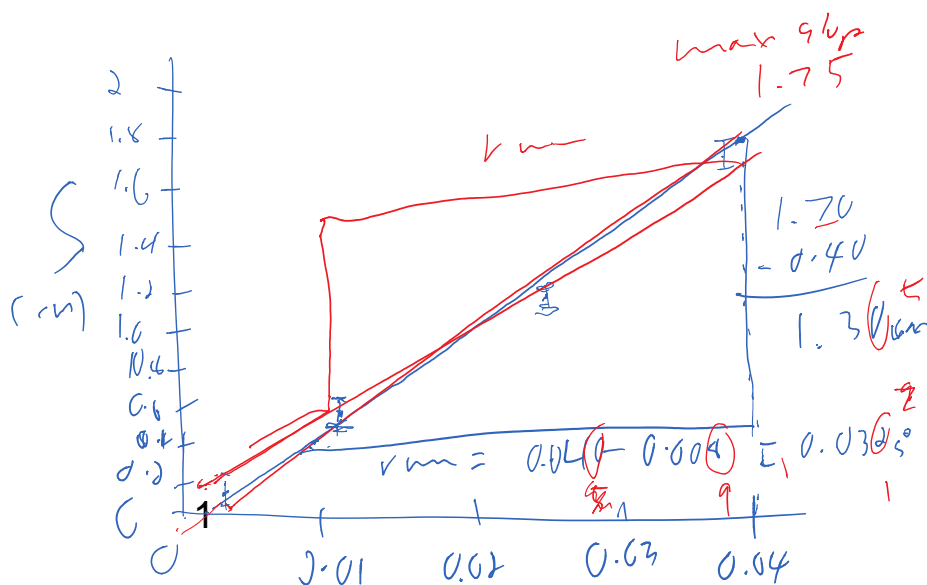


$$y \propto \sqrt{x}$$



$Q$	$10$	$t^2 (s^2)$	$S (cm)$
		0	0.0
		0.00242	0.1
		0.01174	0.5
		0.0258	1.1
		0.0396	1.7

$t^2 \text{ (s}^2\text{)}$	$s \text{ (cm)}$
0	0.0
0.00242	0.1
0.01134	0.5
0.0258	1.1
0.03956	1.7

$$f^2 \text{ uncontainable} = 2x^2 \text{ unattainable}$$


$$Slope = \frac{v_{ind}}{v_{hm}} = \frac{1.30 \text{ cm}^{-1}}{0.632 \text{ s}^2} = \boxed{41 \text{ cm}^{-1} \text{ s}^2}$$

$$\text{max slope} = \frac{46.625 \text{ cm/s}^2}{0.031} = 1504.032 \text{ cm/s}^2$$

Step 0 =  $41 \pm 0.3$  cm

- binomial coefficients

equation  $y = mx + b$  variables

$$T = 4.1 \pm 0.3 \text{ s} + 2 + 0.1 \pm 0.1 \text{ cm}$$

quantities  
with  
uncertainty/  
units

